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(54) Title: FROZEN PRODUCT AND PROCESS FOR THE PREPARATION THEREOF

(57) Abstract

A frozen aerated product having no added emulsifier and preferably no added stabiliser and having a fat content of from 6 to 18 % which satisfies the following conditions: (a) % DF > [2.29 * %F]; (b) % ML100 < 80 % - [5.93 * %F]; and (c) an air cell size distribution such that the mean air cell size is less than 40 μM with a standard deviation of 20 μM; wherein DF = destabilised fat, F = fat, ML100 = mass loss after 100 minutes.

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FROZEN PRODUCT & PROCESS FOR THE PREPARATION THEREOF

Technical Field of the Invention

The invention relates to a high quality frozen aerated product, particularly an ice cream product and the manufacture thereof, wherein the frozen aerated product requires no addition of emulsifiers.

Background to the Invention

Traditionally frozen aerated products such as ice cream products contain stabilisers and emulsifiers in order to provide the desired quality product. However, it is now preferred to provide such products without additives. To date products provided without added stabilisers and emulsifiers have been inferior in quality in that they are fast melting, have a low percentage of destabilised fat, and are unstable to heat shock and hence quickly become very icy. Furthermore, such products have a reduced creaminess perception.

Clearly it would be advantageous to be able to provide a product having no added emulsifiers, and preferably no added stabilisers or emulsifiers which nevertheless retains its high quality.

Frozen aerated products such as ice cream are usually produced by a continuous process comprising the following steps:

a) homogenising of ingredients
b) pasteurisation
c) cooling
d) freezing and aeration
e) extrusion
f) (optional) deep freezing

Normally the homogenisation step takes place in a first vessel, followed by continuous pasteurisation followed by cooling. The mixture is then transferred to a freezer, for example a scraped surface heat exchanger where the product is frozen to a temperature of approximately -6°C followed by quiescent cooling in a hardening tunnel.

The applicants have surprisingly found that if the product is subjected to cooling and shearing in a screw extruder prior to extrusion and any optional deep freezing, a high quality product may be prepared even in the absence of emulsifiers and preferably also in the absence of stabilisers.

Screw extruders such as single screw and twin screw extruders are widely used in the chemical industry for example in the production of plastics. It has also been proposed to use single screw or twin screw extruders in the freezing of ice-cream, see for example EP 561 118 and EP 401 512.

EP 713 650 discloses a method for manufacturing frozen aerated products in which the composition to be frozen is mixed, aerated and cooled to a temperature equal or less than -8°C prior to extrusion in a single twin screw device.

However, to date it has not been recognised that such screw extruders can advantageously be used to prepare a high quality frozen aerated product having no added emulsifiers or stabilisers.

Disclosure of the Invention

Accordingly the invention provides a frozen aerated product comprising;

(i) 6 to 18% fat
(ii) 0% emulsifier
(iii) 0 to 1.0% stabiliser

which satisfies the following conditions:

(a) % DF > [2.29 * %F];
(b) % ML100 < 80% - [5.93 * %F]; and
(c) An air cell size distribution such that the mean air cell size is less than 40 μM with a standard deviation of 20 μM;

wherein DF = destabilised fat
F = fat
ML100 = mass loss after 100 minutes

Preferably the product has from 0 to 0.5% stabiliser, more preferably from 0 to 0.25 % stabiliser, even more preferred from 0 to 0.15% stabiliser, most preferred 0% stabiliser. Products having no stabiliser preferably have an ice crystal distribution such that each ice crystal has less than 1.75 neighbouring crystals touching in a 2D plane;

A convenient process for the preparation of the frozen aerated product according to the invention comprises subjecting the product to be frozen to shear forces and cooling in a screw extruder prior to extrusion and optional deep freezing.

The screw extruder can be either a single or multiple screw extruder, preferably however a single or twin screw extruder is used.

Preferably the product is extruded at a temperature of from -10°C to -30°C, more preferably from -10°C to -25°C, most preferably -10°C to -15°C.

The screw extruder may be employed after the conventional freezing and aeration step within for example a scraped surface heat exchanger. Alternatively all steps prior to extrusion, including if desirable homogenisation and pasteurisation, may be conducted within the screw extruder as described in either EP 713 650 or our copending European patent application EPA 96302718.0

Frozen aerated products according to the invention have been shown to have an increased perception of fat, characterised by increases in creamy texture, thickness, smoothness, initial smoothness and reduction of ice crystal quantity in mouth and ice crystal size in mouth.

The percentage destabilised fat was measured using a solvent extraction technique. 10g of ice cream was melted for 4 hours at ambient temperature before extraction with petroleum solvent. The solvent was evaporated and the extracted destabilised fat was weighed, this was expressed as a percent of the weight of the total fat in the ice cream.

The percentage mass loss after 100 minutes was determined by measuring the weight of melted ice cream every minute over the required time period.

The air cell distribution and ice crystal distribution were determined using low temperature scanning electron microscopy (SEM).

The mean air cell size measured for the products of the invention is thought to be important for providing products having a creamy texture. Conventionally prepared ice cream,

which is stabilised and emulsified will have a mean air cell size of from 60 to 100um.

Preferably the frozen aerated product of the invention is a milk or fruit based frozen aerated confection such as ice cream, frozen yoghurt, sherbet, sorbet, and frozen custard.

Suitable ingredients and their preferred levels for such a frozen aerated confection are for example: Ice cream/custard: milk fat 6-18 wt%, milk solids non fat 2 to 15 wt%, sugar or other sweeteners 0.01 to 35 wt%, flavours 0-5 wt%, water 30 to 85 %wt.

Any stabiliser used in ice cream is suitable, for example Locust Bean Gum (LBG), Carrageenan, Guar gum, gelatin, CMC (Carboxy methyl cellulose) gum, pectin, algin products, and mixtures thereof.

Examples

Example 1

An ice cream mixture having the following formulation:

12% Fat
12% Skimmed Milk Powder
15% Sucrose
61% Water

was prepared in the conventional way and initially frozen in a standard ice cream freezer (scraped surface heat exchanger, SSHE) to a temperature of -6°C. Air was added to the mix in a ratio of 1:1.

The outlet of the SSHE was connected by pipework to a single screw extruder with a refrigerated jacket which continued to freeze the ice cream to a temperature of < -10°C. The single screw extruder had the following geometry:

Barrel length	0.75m
Barrel diameter	0.2m
Screw pitch	0.135m (2 start)
Screw Channel depth	15 mm

The single screw extruder was controlled to maintain a constant inlet pressure of 7 barg and a constant torque on the screw of 1500 Nm. The outlet pressure was 8 barg.

An ice cream product was obtained which was emulsifier and stabiliser free having 28 % destabilised fat, 8.5% mass loss after 100 minutes, and the mean air cell size was 37μM. Each ice crystal had less than 1.5 neighbouring crystals touching in a 2D plane.

Furthermore, the ice-cream was of high quality having an excellent creamy texture and smoothness.

Example 2

An ice cream mixture having the following formulation:

Ingredient	%w/w
Butteroil	8.00
Skimmed Milk Powder	10.00
Sugars	19.58
Stabiliser	0.16
Flavour	0.01
Water	to 100

was prepared in the conventional way and initially frozen in a standard ice cream freezer (scraped surface heat exchanger, SSHE) to a temperature of -6°C. Air was added to the mix in a ratio of 1:1.

The outlet of the SSHE was connected by pipework to a single screw extruder with a refrigerated jacket which continued to freeze the ice cream to a temperature of < -10°C. The single screw extruder had the following geometry:

Barrel length	0.75m
Barrel diameter	0.2m
Screw pitch	0.135m (2 start)
Screw Channel depth	15 mm

The single screw extruder was controlled to maintain a constant inlet pressure of 6 barg and a constant outlet pressure of 4.5 barg. The flow rate was 225 L/hr, and the torque on the screw was 1800Nm.

An ice cream product was obtained which was emulsifier free having 23 % destabilised fat, 22% mass loss after 100 minutes, and the mean air cell size was 35μM.

Furthermore, the ice-cream was of high quality having an

excellent creamy texture and smoothness. The quality of the ice cream was comparable to a conventional product containing 0.3% of emulsifier (a mono/di glyceride blend).

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CLAIMS

1. A frozen aerated product comprising:

(i) 6 to 18% Fat;
(ii) 0% Emulsifier
(iii) 0 to 1.0% Stabiliser

which satisfies the following conditions:

(a) % DF > [2.29 * %F];
(b) % ML100 < 80% - [5.93 * %F]; and
(c) An air cell size distribution such that the mean air cell size is less than 40 μM with a standard deviation of 20 μM;

wherein DF = destabilised fat
F = fat
ML100 = mass loss after 100 minutes

2. A frozen aerated product according to claim 1 wherein the product comprises from 0 to 0.5%, preferably 0 to 0.25% most preferably form 0 to 0.15% stabiliser.

3. A frozen aerated product according to claim 1 or claim 2 wherein the product comprises 0% stabiliser.

4. A process for the preparation of a frozen aerated product according to any preceding claim wherein the product to be frozen is subjected to shear forces and cooling in a screw extruder prior to extrusion and optional deep freezing.

5. A process according to Claim 4 wherein the product to be frozen is initially cooled to approximately -6°C in a freezer before transferring into the screw extruder.

6. A process according to Claim 5 wherein the freezer is a scraped surface heat exchanger.

7. A process for the preparation of a frozen aerated product according to Claim 1, 2 or 3 comprising the steps of

(a) homogenising of ingredients;
(b) pasteurisation;
(c) cooling;
(d) freezing and aeration;
(e) extrusion; and
(f) (optional) deep freezing;

wherein steps (a) to (d) are conducted in a screw extruder.

8. A process according to any one of claims 4 to 7 wherein the screw extruder is a single screw extruder.

9. A process according to any one of claims 4 to 7 wherein the screw extruder is a twin screw extruder.

10. A process according to any one of Claims 4 to 7 wherein the product is extruded at a temperature of from -10°C to -30°C, preferably -10°C to -25°C, most preferably -10°C to -15°C.